

Harvest Factors Affecting Puget Sound Salmon and Bull Trout

"The parties hereto, all Puget Sound treaty tribes and the Washington Department of Fisheries... agree to a philosophy of cooperation in implementing management programs to maintain, perpetuate and enhance the salmonid resources."

Puget Sound Salmon Management Plan, 1985

Harvest is important to the Puget Sound region culturally and economically. The salmon themselves are inherently productive; and when populations are healthy, they can sustain harvest without jeopardizing their ability to sustain themselves. Scientists have determined that the mortality to salmon caused by habitat loss and natural factors exceeds the numbers of salmon taken by fishing. However, because harvest occurs late in the life cycle of the salmon, the risk of overfishing has a direct and potentially substantial effect on the population that is left to return home and reproduce (NRC, 1996).

Fisheries for Puget Sound Chinook and other species are structured around the cultural and legal history of the region, national and international laws and management forums, and the biological characteristics of the salmon themselves. Fishing occurs in waters off of the coast of Alaska and Canada, ocean environments along the Washington coast, and in the marine waters and rivers of Puget Sound. Each of these fisheries harvests a portion of the returning runs of Puget Sound Chinook and Hood Canal summer chum salmon. Although fisheries have not been targeted on the harvest of bull trout, these fish are also captured incidentally during the harvest of other species.

Today's harvest management objectives emphasize the survival and recovery of the wild salmon populations. The management of harvest is a complicated process that crosses traditional tribal geographic boundaries, state jurisdictions and international law. Salmon fishers in Washington include Indians and non-Indians who fish for commercial, recreational, ceremonial and subsistence purposes. Intertribal, tribal-state, interstate and international negotiations must balance the interests of the various fishers with the capacity and conservation needs of the fish, utilizing an extensive array of technical methods to estimate population sizes and run timing. The complex fisheries management structure for this process has evolved during more than 150 years of change to the human and salmon populations of Puget Sound.

History of Puget Sound Fishing

Tribal Fisheries and the Stevens Treaties

Evidence of fishing activity and trade by Puget Sound Indians is obvious in every coastal archaeological dig in the region, dating back thousands of years. Salmon were key elements in the diet, religious practices and trade customs of tribal ancestors, covering a wide geographic area in the Pacific Northwest. Tribes often moved from place to place to take advantage of the different timing of various salmon species, with each tribal band develop-

ing a traditional geographic pattern of fishing sites. These “usual and accustomed fishing grounds and stations” were located throughout tribal territorial areas in marine waters, embayments, and up and down rivers and tributaries. Many fishing stations were located at the mouths of rivers, capturing adult salmon as they returned to their “terminal” areas to complete their life cycle. Although tribes managed their fisheries to allow sufficient numbers of salmon to reach their spawning grounds, extensive regulation was unnecessary due to the abundance of fish and the small human population.

In the mid-1850’s, Isaac Stevens, the first Governor of Washington Territory, was sent by President Franklin Pierce to negotiate with the many tribal communities in order to avoid conflict and secure clear title to the land for the coming influx of white settlers. The “Stevens Treaties” with western Washington and Columbia River tribes contained essentially the same language, by which the tribes ceded their ownership of millions of acres of land, reserved parcels of land for their exclusive use (reservations), and retained some of their rights for

fishing, hunting and gathering throughout their former territory. The treaties were not a grant of rights to the Indians, but were rather a grant of rights from them, reserving those rights which they had not signed over to the Federal government (Cohen, 1986; Madsen, 1988).

“The right of taking fish, at all usual and accustomed grounds and stations, is further secured to said Indians in common with the citizens of the territory..”

Treaty of Medicine Creek, 1854

Expansion of Non-Indian Fisheries in the 19th and 20th Centuries

The arrival of the salmon canning industry in Puget Sound in the 1870’s led to an explosion in the non-Indian commercial fishing industry, with a peak cannery pack of 95,210 cases of Chinook in 1908. As catch rates grew, fishers expanded their harvest to more species and moved further out toward the ocean to avoid conservation closures of river fisheries, already needed by about 1915.



Reenactment of the Point No Point treaty.

Photo Courtesy NWIFC

The First Salmon Ceremony

Early anthropologists in the Pacific Northwest documented the practice of First Salmon Ceremonies, a ritual of giving thanks that is still held by many tribal communities. First salmon ceremonies are generally conducted in the spring, coinciding with the arrival of the first salmon runs, to welcome the return of the salmon and to thank tribal relatives in the oceanic world for allowing themselves to be killed and provide food. Although each tribe has their own traditions, generally a salmon is specially prepared and shared, and songs are sung to welcome the salmon as an honored guest. The community celebrates the cycle of the salmon to ensure that the runs will return, and often include prayers for the safety of the fishermen. The remains of the honored salmon are usually wrapped and returned to the water, so that the salmon can tell its people that it was treated well.



Photo courtesy NWIFC

2002 Swinomish First Salmon Ceremony

Washington harvest rates declined somewhat between World Wars I and II due to the Great Depression as well as surplus catches from Alaska, and expanded again after World War II, particularly in ocean fisheries. High seas fishing by Japan and other nations also became increasingly contentious. The 1976 Magnuson Fishery Conservation and Management Act asserted a 200-mile exclusive fishery management zone off of the coast of the



From the collections of the Washington State Archives

United States. This act along with other international agreements substantially reduced the interception of North American salmon on the high seas. (NRC, 1996)

Recreational hook-and-line fisheries became important following World War II and presently comprise the bulk of Chinook harvest by non-Indian fishers in Puget Sound marine waters. By 1957 the Puget Sound recreational Chinook harvest had reached 238,000 fish before size and bag limits were reduced in 1958. Prior to 1958, the daily limit was 6 fish greater than 12 inches, only 3 greater than 24 inches. From 1958 through 1970 the catches ranged between 100,000 and 160,000 Chinook. Recreational catches rose again in the early 1970s, possibly due to hatchery supplementation programs, and have dropped to levels less than 45,000 Chinook since 1998 (WDFW, 2005).

The Boldt Decision

"The expansion of ocean fisheries placed the burden of responsibility for conservation on fishers closer to the spawning grounds, including the American Indians" (NRC, 1996). The fishing pattern of non-Indian harvest in open waters of the Pacific Ocean and Puget Sound left few, if any, fish that could be harvested in many traditional terminal areas by the river mouths or in streams. By 1960, the Indian harvest in Puget Sound and coastal waters was 5 percent of the total catch; Indian fishers began harvesting in open defiance of state regulations, and were frequently jailed.

The 1974 "Boldt Decision" in U.S. v. Washington

(384 F.Supp.312) and related legal opinions interpreted the treaty language to mean that tribes had reserved the right to take 50% of the harvestable fish. The United States Supreme Court affirmed the decision and recognized the inextricable cultural relationship between Pacific Northwest tribes and salmon, indicating that, “Fishing is not much less necessary to the existence of tribes than the atmosphere they breathe.” The decisions provided direction for the conservation of fisheries resources, established treaty tribes and the states as co-managers, and set out principles to distribute the burden of conservation fairly. It should be noted that the provisions of U.S. v. Washington did not extend to tribes that did not have treaty fishing rights. Thus the terms “treaty” and “non-treaty” are now used



Photo courtesy Northwest Indian Fisheries Commission.

Allison Gottfriedson under arrest.

to describe the respective fishers from each of the co-management entities.

Despite the early strife and sporadic ongoing disputes, the State of Washington and treaty Indian tribes developed a cooperative management structure in the ensuing decades. The “philosophy of cooperation” expressed in the 1985 Puget Sound Salmon Management Plan and other key management agreements has enabled the co-managers to coordinate their response to salmon recovery through harvest management forums, as well as habitat restoration and hatchery operations.

Fishing no longer provides the level of sustenance and livelihood that it once did for either the treaty or non-treaty fishers of Washington. The number of participants in ocean troll (hook and line) fisheries has substantially declined, and the average landings by weight in the 1990’s were only 43% of those in the 1980’s (NRC, 1996). Within Puget Sound fisheries, the Chinook catch by non-treaty commercial net fishers declined by 93% from 1975 to 2003 and marine recreational fisheries (non-treaty) declined by 91% during the same period (WDFW, 2005). The commercial net catch of Chinook for treaty fishers in Puget Sound declined by 23% during the same period, despite the proportional increase in allocation resulting from US v. Washington. Conservation principles are embedded in the legal structure that governs management under U.S. v. Washington, and the curtailment of fisheries to protect rapidly declining runs was instituted by the co-managers well in advance of the listing under the Endangered Species Act.

Salmon Harvest Management Forums

Today a complex array of agencies and governments manage the fisheries on salmon as they migrate through Alaskan, Canadian, Washington and Oregon waters. State and tribal fisheries harvest managers in Washington must consider the effects of Washington fishing regulations on Columbia River and Canadian salmon populations, and in turn, the effects of fishing outside of Washington

on Puget Sound salmon. The complex political and legal structures that frame harvest management of Puget Sound salmon are largely concentrated in three major forums: 1) the Pacific Salmon Commission, established by a treaty between the United States and Canada, oversees fishing on salmon traversing US and Canadian waters; 2) the Pacific Fisheries Management Council provides the forum for the negotiation and regulation of ocean fisheries along the US West Coast; and 3) U.S. v. Washington proceedings provide the structure for harvest management in the Strait of Juan de Fuca and Puget Sound waters (Figure 3.13 Ocean and Coastal Fisheries Management Forums).

Pacific Salmon Treaty

The Pacific Salmon Treaty between the United States and Canada was finalized on March 17, 1985 to address the management of salmon stocks that originate in one country and are intercepted by the other. The countries are committed to equitable sharing of the harvest and to constrain harvest on both sides of the border to rebuild depressed salmon stocks. The Pacific Salmon Commission oversees the implementation of the Treaty and the specific management provisions known as “annexes” which are subject to periodic revision. The most recent update to the annexes was agreed to in 1999 and is applicable through 2008.

Pacific Fisheries Management Council and the North of Falcon Process

“The Pacific Fisheries Management Council (PFMC) was created by the Magnuson Fishery Management and Conservation Act in 1977, and re-authorized by passage of the Sustainable Fisheries (Magnuson-Stevens) Act by the United States Congress in 1997. The Council coordinates and oversees the ocean fishery management objectives among the three state jurisdictions (Washington, Oregon and California) by mandating regulations that prevent overfishing and maintain sustainable harvest. The function of the Council is to assure

that the co-managers’ conservation objectives are achieved for all Chinook and coho salmon stocks, and that harvest is equitably shared among the various user groups.” (NMFS, 2004) Washington fisheries managers are particularly involved with the North of Cape Falcon process, governing the harvest regime between Cape Falcon, Oregon (just south of the Columbia River) and the U.S.-Canadian border. Since the ocean fisheries forums set the context for all fishing that follows in the Strait of Juan de Fuca and Puget Sound, annual fishing regimes for most Puget Sound salmon populations are negotiated within this forum. The annual series

Major Harvest Management Forums Affecting Puget Sound Salmon

Pacific Salmon Commission

(Established through the U.S.-Canada Salmon Interception Treaty of 1985)

- **U.S. Commission Members:** U.S. State Dept., Washington Dept. of Fish & Wildlife, Oregon Dept. of Fish & Wildlife, Tribal Representative
- **Joint Advisory Committees:** Northern Panel, Southern Panel, Fraser River Panel

Pacific Fisheries Management Council

(Established under the Magnuson Fisheries Conservation and Management Act of 1976)

- **Voting Members:** NMFS, WDFW, ODFW, Idaho Dept. of Fish & Wildlife, California Dept. of Fish & Wildlife, 8 citizens.
- **Standing Committees:** Salmon Advisory Subpanel, Scientific and Statistical Committee, Salmon Technical Team

US v. Washington

- Washington Department of Fish and Wildlife
- Washington Treaty Indian Tribes

Figure 3.13 Ocean and Coastal Harvest Management Forums



National Marine Fisheries Service, Northwest Region (2003)

Figure 3.14 Ocean and Coastal Fisheries Management Forums (NMFS, 2004)

of PFMC and North of Falcon meetings receive active participation from state and tribal co-managers as well as individual commercial and sport fishing groups, and charter operators. Representatives from environmental organizations and others involved in salmon recovery are also encouraged to participate.

US v. Washington

The Federal court proceedings of US v. Washington are the legal framework for the joint management of salmon fisheries within Puget Sound and the Strait of Juan de Fuca. Treaty tribes that are parties to US v. Washington and the State of Washington Department of Fish and Wildlife are the co-managers of the salmon and steelhead resources returning to western Washington. Seventeen of the

treaty tribes are based in Puget Sound, and their locations are shown in Figure 3.15.

Puget Sound Salmon Management Plan:

Harvest under U.S. v. Washington is largely guided by the 1985 Puget Sound Salmon Management Plan (US v. Washington, F. Supp. 1606:1405). The plan remains the framework for negotiating annual harvest regimes, implementing management objectives, and the allocation of harvest between the State of Washington and treaty tribes and between the tribes themselves. Management strategies are designed to provide opportunity for all parties while sharing the burden of conservation. Several principles for the management of fisheries in Washington were reinforced by the plan, including the need to allow an adequate

proportion of returning runs of salmon to “escape” from fisheries to maintain both natural and artificial production. The PSSMP also emphasized the need to base allocation and management on the region of origin of returning salmon populations, and to protect weak stocks of salmon when setting up harvest shares, areas and time. Procedures for negotiation and the timely exchange of information were also established, along with principles for sharing and contingencies.

Comprehensive Management Plan for Puget Sound Chinook

The Puget Sound Chinook Harvest Resource Management Plan was jointly developed in 2004 by the Washington Department of Fish and Wildlife and the Puget Sound treaty tribes under Limit 6

of the Endangered Species Act 4(d) Rule for the 2004-2009 fishing years. The Resource Management Plan regulates commercial, recreational, ceremonial, and subsistence salmon fisheries taking place within Puget Sound and the Strait of Juan de Fuca and potentially affecting Puget Sound Chinook Salmon. The co-managers' plan establishes "Re-building Exploitation Rates" for most Chinook populations in Puget Sound, which are intended to be conservative rates of harvest that should contribute to the recovery of threatened populations. Additionally, all Puget Sound Chinook populations have "Low Abundance Thresholds" that trigger additional conservation measures in United States fisheries when pre-season forecasts fall below certain

levels or when US fisheries alone cannot achieve the harvest objectives. More information on the Comprehensive Chinook Resource Management Plan is described further in the section on regional recovery strategies contained in this recovery planning document.

Seasonal Harvest Management

Within the major harvest management forums, fisheries managers go through a number of steps to establish an annual harvest schedule incorporating an assessment of the effect of proposed harvest regimes on threatened populations of Chinook and summer chum.

Pre-season Planning:

- Pre-season planning generally begins in December, with the preparation of data from previous run sizes and harvest levels. A preliminary forecast of the expected returns to Puget Sound fishing areas is made in January, and plugged into a simulation model that allows fisheries managers to estimate the impact of alternative fishing regimes on harvest and escapement
- Harvest limits for natural-origin Puget Sound Chinook are determined by the co-managers' plan (PSIT & WDFW, 2004) and provisions of the Pacific Salmon Treaty or other criteria. Harvest limits for hatchery-origin Puget Sound Chinook and other salmon species are determined by the Puget Sound Salmon Management Plan and other harvest management plans adopted under its auspices as well as provisions of the Pacific Salmon Treaty, where applicable.
- The annexes of the Pacific Salmon Treaty between the US and Canada

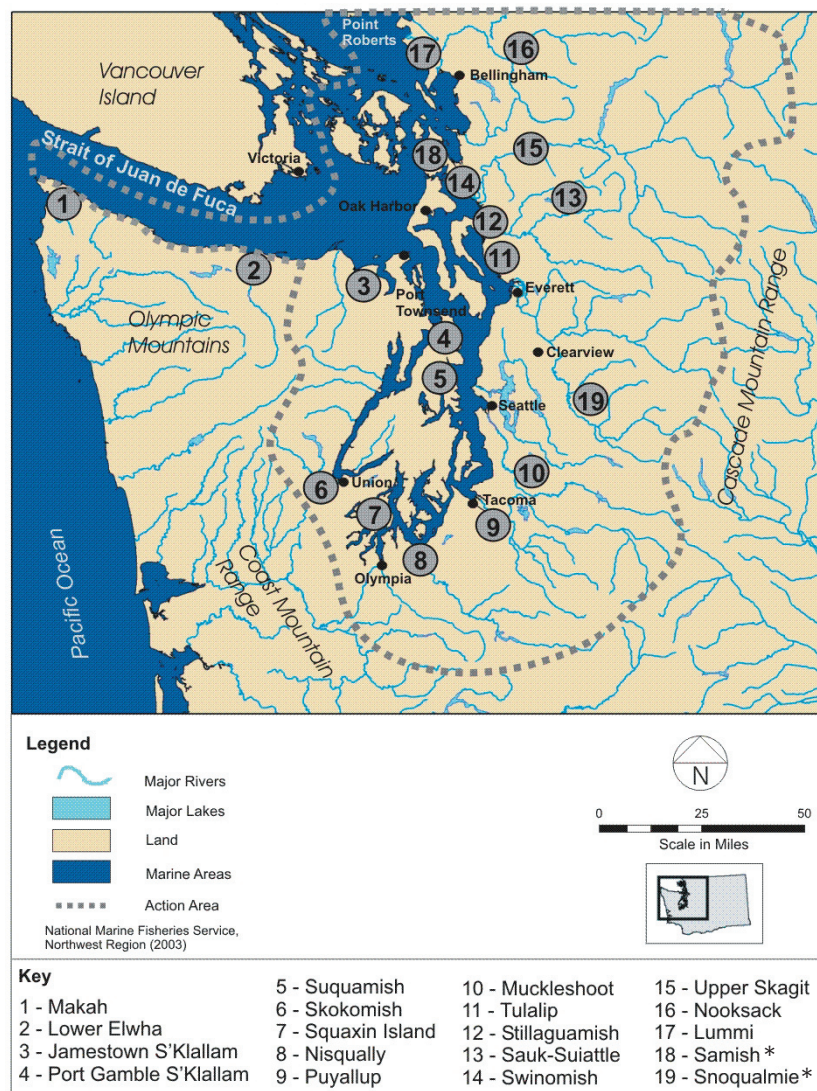


Figure 3.15 Federally recognized tribes.

operate on a parallel track for early pre-season planning. Each year, details of abundance forecasts, fisheries assessments, monitoring and fishing proposals are reviewed and decisions on fisheries implementation and management are made. Of primary importance to Washington State Chinook fisheries planning is the annual forecast of Canadian interceptions of US Chinook that is authorized by the Pacific Salmon Treaty and predicted to occur. This forecast is an essential input for the simulation modeling. The PSC process begins in January and intersects with the PFMC / North of Falcon process in March.

- As the PFMC / North of Falcon planning proceeds, information is updated, and model simulations are generated, looking for the appropriate fishing levels and balances to protect Chinook stocks based on their status. This process involves considering management controls such as the timing and locations of the various fisheries from the ocean to the terminal areas. The model results are used to ensure that the harvest rates are not exceeded for each individual stock as well as the cumulative harvest rates for a group of populations, such as Puget Sound Chinook.
- Once the proposed fisheries regimes have been reviewed, a decision is made by the PFMC on ocean fisheries and the Washington State co-managers (WDFW and the tribes) agree on an annual plan for the Strait of Juan de Fuca and Puget Sound fisheries. This fisheries plan includes the specific times, locations and other provisions (e.g., Chinook release requirement, size limit) of all the inside fisheries to occur that year. These decisions are

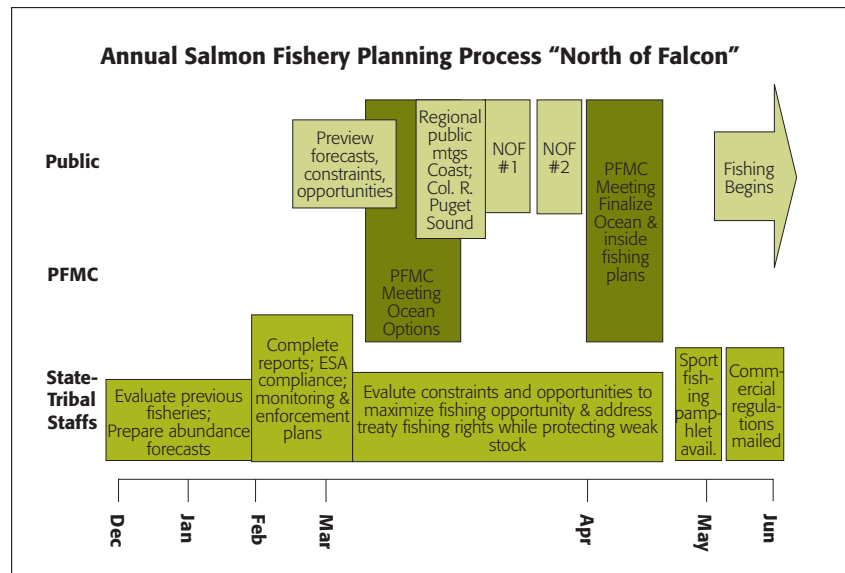


Figure 3.16

Source: T. Scott, WDFW

generally reached in April of each year, but may extend into the summer and fall fishing season.

In-Season and Post-Season Management:

Fisheries schedules and regulations are often adjusted during the fishing season as better information becomes available on the abundance of various Puget Sound salmon populations. Managers must ensure that quotas are not exceeded. Commercial fisheries may be adjusted up or down based on updated information on the abundance of incoming runs. In each case, particular attention is paid to the impact to critical populations from potential changes to the harvest regime. Following the end of the season, fisheries managers collect monitoring data, evaluate the results and incorporate them into planning for future seasons.

Enforcement:

WDFW enforces commercial and recreational fishery regulations for the fishers under state jurisdiction. As of 2004, the WDFW Enforcement Program employed 150-170 personnel, of which 95% are fully commissioned Fish and Wildlife officers. Tribal fishery regulations are enforced by the individual tribe promulgating the regulation, both on and off the reservation, and enforcement officers generally attend the Federal law enforce-

Common Harvest Management Terms:

Terminal Fishery refers to fishing at a location (terminal area) which represents the endpoint of the geographic migration cycle for a run of salmon--usually a river or embayment at the mouth of a river. Terminal fisheries capture returning adult salmon that are generally part of the same population heading for their spawning grounds, which have sorted themselves from salmon originating in other river systems. However, multiple species can be mixed together in terminal areas.

Directed Fisheries are those fisheries that are regulated to target on a particular species or population by restricting fishing areas, gear type and timing.

Incidental Catch is often used synonymously with "bycatch" and refers to fish that are caught incidentally while fishing for a different species, or populations of the same species, in a directed fishery.

Escapement is the number of adult fish that survive harvest or natural mortality and return to spawn to a particular geographic area.

Exploitation Rates are calculated as the percentage of the **total return** that is caught in fisheries. The total return is the catch + broodstock take for hatcheries or other supplementation programs + escapement to spawn naturally.

Pre-terminal or Mixed Stock Fishing Areas are the marine areas in the Pacific Ocean, Strait of Juan de Fuca and Puget Sound through which salmon originating from different river systems migrate on their way to their natal stream. Many species and populations may be mixed together in these areas.

Treaty and Non-Treaty Fisheries refers to the harvest by fishers with tribal treaty-reserved fishing rights exercised under the terms of US v. Washington, and harvest that falls under the jurisdiction by the State, respectively.

Commercial fisheries refers to fishing that is conducted to sell all or a portion of the catch, as opposed to **subsistence, take home, and sport or recreational fisheries** in which the fisher keeps the harvested fish for their personal consumption. Sport/recreational fishing is generally associated with catch by non-treaty fishers, while the term **subsistence fisheries** refers to catch obtained or retained for personal use by treaty tribal fishers.

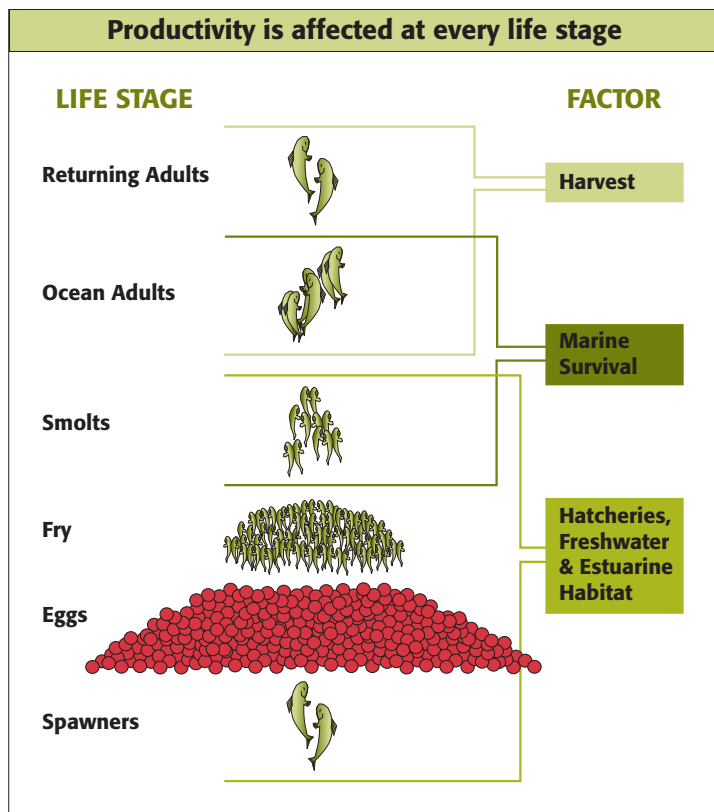
Ceremonial fisheries are conducted by treaty tribes to provide fish for funerals, tribal gatherings and other ceremonies involving the larger tribal community.

Troll fisheries are operated with hook and line equipment for either commercial or recreational purposes, as distinguished from **net fisheries** which utilize gill net, beach seine or purse seine equipment and are used in commercial fisheries. Both gear types have been used for ceremonial and subsistence fisheries.

ment academy for training. Several tribes operate enforcement consortia or utilize cross-deputization agreements where tribes fish in common areas. Violations are prosecuted in the respective state or tribal court systems. State and tribal law enforcement agencies cooperate with the US Fish and Wildlife Service, NMFS enforcement branch and the U.S. Coast Guard in the course of their enforcement duties.

Harvest Management and Salmon Abundance/ Productivity

Freshwater conditions, marine survival and harvest all affect the productivity of a salmon population, i.e. the number of returning adult progeny per spawner. Freshwater and marine habitat conditions can affect the rate by which eggs hatch, juvenile salmon survive and transition to seawater



(Source, WDFW & NWIFC)

Figure 3.17 Salmon productivity is affected at every life stage.

(smoltify), and migrate to ocean environments where they mature. Ocean conditions, predation and harvest directly affect the proportion of the adults that return to spawn (Figure 3.17).

Productivity and Harvest

When a salmon population is merely replacing itself, the relationship between the parent salmon

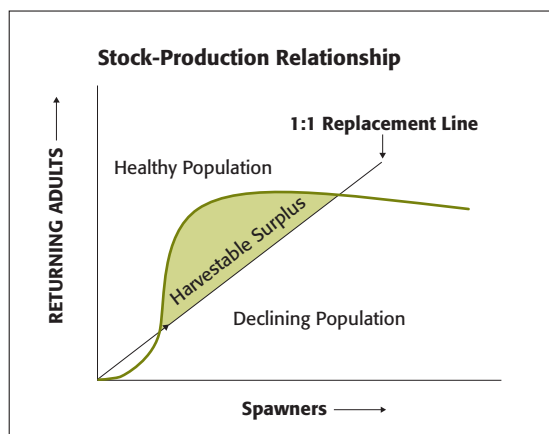


Figure 3.18 Productivity affects the ability of populations to replace themselves and provide a harvestable surplus.

and their returning offspring is a 1-to-1 ratio. The productivity of some Puget Sound Chinook populations is presently less than the level of replacement. One of the characteristics of viable, healthy populations is to have a level of productivity that is greater than the 1-to-1 replacement rate. These populations may have what is known as a “harvestable surplus”, i.e. a portion of the population that can be harvested without affecting the population’s ability to replace itself (see figure 3.18).

Fisheries managers set the rates of harvest so as to allow adequate “escapement” from the fisheries that intercept adult salmon as they migrate. Estimating the number of fish that will return in advance and setting rates that will not impinge on the ability of a population to replace itself is a difficult task. The level of abundance of salmon populations varies from year to year, and different populations may require additional conservation measures in certain

return years. In cases where the population levels are already very low, fisheries managers must ensure that harvest does not impede the ability of the populations to rebuild.

Reduction of Exploitation Rate in Puget Sound Chinook Fisheries

The objective of the current harvest management plan (PSIT and WDFW 2004) is to ensure that harvest will not significantly impede progress towards population recovery by keeping the rate of harvest low. Fisheries managers use the term “exploitation rate” to refer to the percentage of a total return of salmon that is taken in fisheries. The exploitation rates for Puget Sound Chinook populations of concern have declined by 44 to 64% between the periods 1983-1987 and 1998-2000, and have been held to this low level for the last few years (PSIT & WDFW, 2004). (See Figure 3.19 for an example for Snohomish Chinook.)

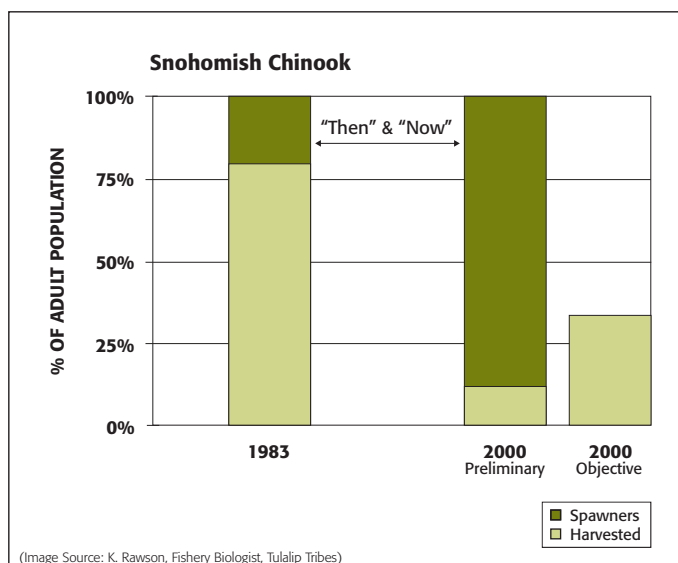


Figure 3.19 Comparison of the % of adult Snohomish Chinook harvested in 1983 and 2000.

Despite the low harvest levels of recent years, several populations have not been able to rebuild. Fisheries managers have concluded in many cases that further reduction in fishing is not feasible (due to habitat impairment and limited jurisdiction over certain fisheries), nor is it likely to contribute to rebuilding wild populations of salmon. Data comparing hatchery-origin fish to naturally-spawned fish have indicated that reduced exploitation rates (along with more favorable ocean conditions) are increasing the number of hatchery-origin fish that return to spawn. Unfortunately this is not the case for natural-origin Chinook returns which, though stabilized, have not increased. This information points to the condition of freshwater habitat as the factor constraining natural salmon production, indicating that the conservative levels of harvest now being implemented do not impede recovery (PSIT & WDFW, 2004).

Snohomish Chinook provide an example of the apparent disconnection between spawner numbers and productivity in some Puget

Sound Chinook populations (figure 3.20). Harvest has been reduced to very low levels resulting in a relatively constant number of spawners. Despite the maintenance of a constant number of spawners, the total abundance continues to decline. Fisheries managers attribute this situation to factors affecting the survival of offspring to adulthood, such as habitat conditions (WDFW, 2005).

Directed Fisheries and Incidental Catch

Fisheries managers distinguish between “directed” fisheries which target a particular species for harvest, and the “incidental” catches of other species which occur because the various species are mixed in Pacific Ocean and Puget Sound marine areas. Directed fisheries can also target a particular population, such as a hatchery-origin stock, and may result in the incidental take of wild fish from the same species. Where threatened or weak populations of fish may be at risk of incidental catch, the managers shape “selective” fishing regulations in an attempt to avoid harvest of the weak stocks. This can be accomplished by limiting harvest to specific areas, and timing openings to avoid the peak of a weak salmon run. Regulations can specify types of gear, and require the release of all live Chinook that are harvested during

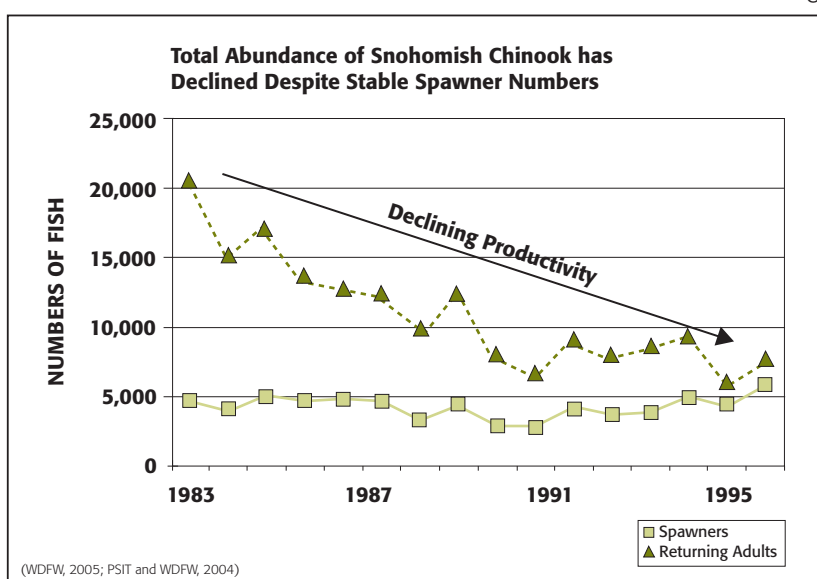


Figure 3.20 Number of Snohomish Chinook spawners and returning adults 1983-1998

an opening. Both directed fisheries and incidental catch are evaluated in establishing exploitation rates for Puget Sound salmon fisheries.

Additional Mortalities Related to Harvest

Commercial and recreational fisheries also result in “non-landed mortality” on Chinook and other species which varies by the type of gear. Even fisheries designed to be selective either for species or to harvest specially marked hatchery fish will have some mortality associated with the hooking and handling of the released fish. These include fish that are brought to the boat but are released because they are too small (may die from hooking trauma), fish that are hooked but drop off before they are brought to the boat, and fish that die from entanglement in gillnet or purse seine gear and drop out before being landed. For each type of fishery (commercial troll, recreational, net, etc.), harvest managers add between 5 and 50% percent to the total catch to account for fish deaths due to release, drop-off and other harvest related impacts (PSIT & WDFW, 2004).

Marine mammals are opportunistic feeders that take advantage of the chance to eat fish from lines or nets before they can be brought to the boat. Marine mammal predation is a substantial source of salmon mortality in many areas of Puget Sound but their effect varies widely from year to year and area to area. In the 1994 Amendments to the Marine Mammal Protection Act (MMPA), Congress directed that a scientific investigation be conducted to “determine whether California sea lions and Pacific harbor seals a) are having a significant negative impact on the recovery of salmonid fishery stocks which have been listed as endangered species or threatened species under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), or which the Secretary finds are approaching such endangered species or threatened species status; or b) are having broader impacts on the coastal ecosystems of Washington, Oregon, and California.” A working group was established by NMFS and reported that

sea lion and harbor seal populations have been increasing, and that the interaction of these marine mammals with commercial and recreational fisheries on the West Coast are on the rise. However, the working group indicated that there was insufficient information to determine ecosystem level impacts and a number of research efforts were recommended (NMFS, 1997).

Puget Sound Chinook Catch

Puget Sound Chinook salmon are captured in fisheries that occur in Alaskan and Canadian waters, ocean fisheries off of the West Coast of the contiguous United States, and within the marine waters and freshwater tributaries of the Strait of Juan de Fuca and Puget Sound. These fisheries are conducted for commercial purposes, for sport/recreational catch, or for tribal ceremonial and subsistence objectives. Puget Sound Chinook are captured through fisheries that are directed at the harvest of Chinook but are intended to catch populations that are not threatened, such as hatchery-origin fish; or they may be harvested as incidental catch during fisheries for coho and other species of salmon. Chinook are captured using “troll” gear (hook and line) or they may be taken in a variety of net gear types. The impact of these fisheries varies area by area, season by season and differs for individual populations of Chinook.

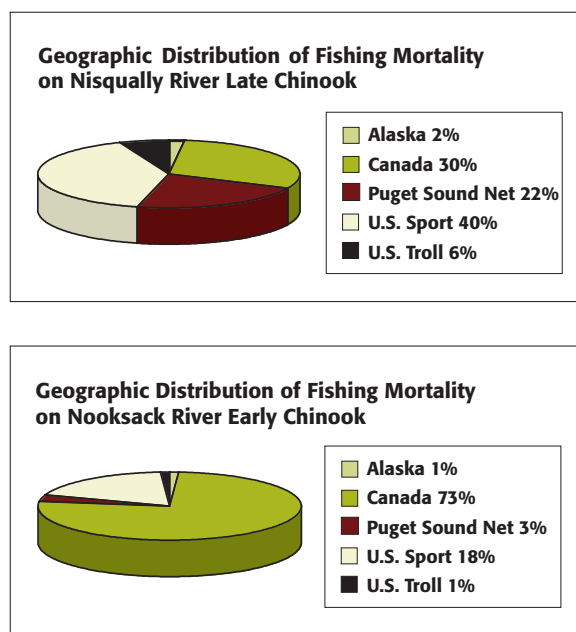
Alaskan and Canadian Interceptions of Puget Sound-Origin Chinook

Chinook salmon originating in Puget Sound rivers are harvested in Alaska and Canada. Harvest in Alaskan and Canadian waters falls largely under the management of the Pacific Salmon Commission. For many Puget Sound Chinook populations, the majority of the total harvest occurs in these fisheries. Data which indicate the proportion of the catch taken by any given fishery (e.g. Canada, Alaska) is generally derived from coded wire tags that are inserted into juvenile salmon from hatcheries before their release.

Alaskan interceptions are relatively small; generally 5% or less of any given Puget Sound Chinook run is harvested in Alaska. The Elwha Chinook population and some Skagit Chinook are exceptions, since Alaskan catch accounts for a little less than 10% of the total run of Elwha Chinook which were released as fingerlings, and 12-13% of Skagit summer fingerlings (PSC, 2004).

A number of troll and net fisheries operate in Canadian waters off of the West Coast of Vancouver Island, Georgia Strait, northern British Columbia, Strait of Juan de Fuca, and marine waters between Vancouver Island and the British Columbia mainland. Canadian fisheries managers implement constraints on their fisheries similar to their US counterparts, with area closures, timing, and size restrictions to conserve weak Canadian and US Chinook and coho stocks. Due to the abundance of other Chinook populations in northern British Columbia waters, Puget Sound Chinook make up a small portion of the catch there. However, these fisheries can account for a large portion of the mortality of Puget Sound Chinook populations originating from the north Olympic Peninsula and northern Puget Sound.

The impact of Canadian harvest on Puget Sound Chinook populations varies significantly for each river system. Georgia Strait fisheries have heavy impacts on North Sound and Hood Canal stocks. West Coast Vancouver Island fisheries have a major impact on all Puget Sound early and late-timed populations of Chinook (PSIT & WDFW, 2004). Canadian harvests generally have a higher proportional impact on populations originating from areas closer to Canada, i.e. in the Strait of Juan de Fuca and northern Puget Sound, than on southern Puget Sound populations. For example, figure 3.21 shows that 73 percent of the Nooksack River early-timed Chinook that are caught in various fisheries are harvested in Canada, while the Canadian portion of the harvest of late-timed Nisqually River Chinook is estimated to be 30 percent. A river-by-river summary of the geographic distribution of fishing mortality, such as those shown in figure 3.21,



(NMFS, 2004)

Figure 3.21 Comparison of the Geographic Distribution of Fishing Mortality on Nisqually River Late-timed Chinook and Nooksack River Early Chinook. Distribution of fishing mortality based on coded-wire tags recoveries of Puget Sound Chinook.

is contained in the Draft Environmental Impact Statement for the Puget Sound Chinook Harvest Resource Management Plan (NMFS, 2004).

Because Puget Sound Chinook were listed as threatened under the Endangered Species Act, the US federal government was required under section 7 of the Act to conduct a consultation that considered the impacts of Chinook harvest management under the Treaty. The consultation was completed and the National Marine Fisheries Service issued a Biological Opinion in November 1999 (NMFS 1999). In that Opinion, NMFS stated that:

"[Reductions pursuant to the Treaty] in combination with other reductions that may occasionally be necessary in southern U.S. fisheries, will be sufficient to meet rebuilding exploitation rate (RER) targets for the larger, more productive stocks in Puget Sound like Upper Skagit summer Chinook. However, the analysis suggests that the exploitation rate reductions secured by the agreement will not be sufficient to meet RERs for smaller, less productive stocks that may already be close to critical threshold levels....However, ... it is highly unlikely that rejection of this agreement

would lead to a better or more restrictive management regime in the foreseeable future.” ...

“Although the exploitation rate savings secured by the agreement for some components of Puget Sound Chinook may not be fully sufficient, they are very significant for many Puget Sound stocks and for other ESUs.....NMFS concludes that the alternative which carries the greatest benefit for the listed Puget Sound Chinook is the entry into force of the agreement and to employ the mechanisms in the agreement itself to address, more surgically, the deficiencies that are apparent with respect to several of the individual stocks of PS Chinook where warranted.”
(NMFS 1999)

Tribal and state co-managers of Puget Sound Chinook remain concerned about the increased risk of under-escapement for some depressed Puget Sound Chinook under current levels of Canadian and Alaskan impacts and the additional constraints on Washington fisheries required to protect Chinook. The topic will be discussed during the development of a new Chinook regime for fisheries after 2008. In the interim, the tribal, state and federal managers have indicated their intent to continue to work with Canadian managers both to employ the mechanisms of the agreement and to find opportunities for reductions beyond those provided in the agreement that may be needed to address critical conservation concerns and that would provide additional benefits for Puget Sound Chinook populations.

Ocean Fisheries along the Washington Coast

Because most Puget Sound Chinook migrate north to Canadian and Alaskan waters, Puget Sound Chinook populations comprise less than 10 percent of the Washington coastal troll and sport catch overall. The contribution of Puget Sound populations to the catch is generally higher in the northern

coastal areas and the mouth of the Strait of Juan de Fuca. Less than one percent of most of the individual Puget Sound Chinook populations is estimated to be harvested along the Washington coast. However, the rates vary annually depending on the abundance of Columbia River and British Columbia Chinook, which are co-mingled with Puget Sound stocks, as well as Chinook from local coastal rivers (PSIT and WDFW, 2004) and (NMFS, 2004).

Commercial Fisheries off the Washington Coast:

A Chinook troll fishery occurs 10 to 40 miles offshore and targets the harvest of Chinook in May and June, and coho in July through mid-September. Quotas (catch ceilings) are developed during pre-season harvest planning and are modified annually due to the variation in abundance of the species. From 1998 to 2004, commercial troll catch along the Washington coast has ranged from approximately 18,000 to 94,000 (Figure 3.22). Recent ocean fishing opportunities and catches have increased as ocean survival conditions became more favorable in the early 2000s, yielding higher abundances for most salmon stocks.

Year	Treaty Troll	Non-Treaty Troll	Recreational	Total
1998	14,859	5,929	2,187	22,975
1999	27,664	17,456	9,887	55,007
2000	7,770	10,269	8,478	26,517
2001	28,100	21,229	22,974	72,303
2002	39,184	53,819	57,821	150,824
2003	34,629	56,202	34,183	125,014
2004	49,175	35,372	24,910	109,457

Table 3.22 Commercial troll and recreational landed catch of Chinook in ocean fisheries along the Washington coast (Areas 1-4), 1998-2004. Note that Puget Sound Chinook populations comprise less than 10% of the catch in these fisheries. (PSIT and WDFW, 2004; PFMC 2005)

Recreational Fisheries along the Washington Coast:

Recreational fisheries in Washington ocean areas are also conducted under specific quotas and allocations, and are monitored by WDFW at each port to keep within the quotas. From 1998 to 2004, the recreational Chinook catch ranged from 2,200 to 58,000.

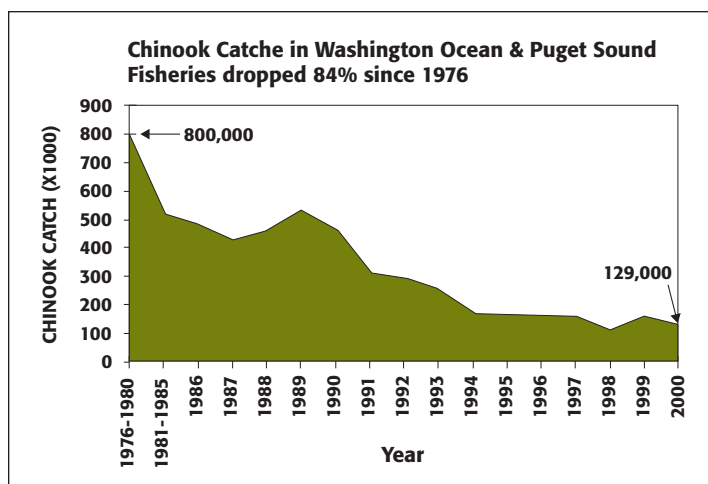


Figure 3.23 Total Chinook Catch in Washington Ocean and Puget Sound Fisheries, 1976 - 2000

Puget Sound and Strait of Juan de Fuca Fisheries

Commercial Chinook Harvest in Puget Sound and the Strait of Juan de Fuca:

"Total commercial net and troll harvest of Chinook salmon [in Puget Sound] has fallen from levels in excess of 200,000 in the 1980's to an average of 64,000 Chinook salmon for the period 1997 through 2001." (NMFS, 2004)

Commercial fisheries for Chinook in the Puget Sound region consist of small-scale directed fisheries targeting hatchery populations, commercial troll fisheries in the western Strait of Juan de Fuca, and the incidental catch of Chinook during fisheries on other species. These fisheries are subject to seasonal and area closures to protect threatened populations.

Commercial directed:

- A few commercial fisheries that are generally directed at abundant hatchery Chinook production occur in terminal

areas such as Bellingham/Samish Bay and the Nooksack River; Tulalip Bay; Elliott Bay and the Duwamish River; Lake Washington; the Puyallup River; the Nisqually River; Budd Inlet; Chambers Bay; Sinclair Inlet; southern Hood Canal; and the Skokomish River.

- Commercial troll fisheries directed at Chinook occur in the western Strait of Juan de Fuca in the winter and early spring, but are closed in mid-April to mid-June to protect maturing early-timed Chinook. Portions of the western Strait fishery are managed under ocean troll regulations, and schedules and quotas differ in these areas. The annual harvest of the directed troll fishery in the western Strait of Juan de Fuca generally ranged from 1,000 to 3,000 from 1997 to 2003 (PSIT & WDFW, 2004; WDFW, 2005). A harvest of 20,197 Chinook occurred in the 2004 - 2005 treaty troll fishery in the western Strait of Juan de Fuca. Pre-season projected total catch for the Strait troll fishery was 2,650 Chinook. The fishery was closed on February 3, 2005 in order to limit catch to near 20,000 (Makah Tribe & NWIFC, via WDFW, 2005).

Incidental Catch: Most of the commercial harvest of Chinook in Puget Sound waters consists of



Photo by Dan Kowalski

Year	Catch (thousands of fish)				
	Chinook	Coho	Pink ^a	Sockeye	Chum
1971-1975	165.1	748.4	2,055.4	2,192.0	408.4
1976-1980	239.5	901.1	3,091.1	1,365.4	699.4
1981-1985	228.9	950.8	3,303.5	1,833.5	750.3
1986	222.8	1,342.1	.1	2,735.6	1,147.1
1987	212.1	1,769.6	2,063.0	1,938.3	1,282.0
1988	230.6	1,228.4	.1	838.1	1,552.1
1989	250.4	958.7	3,419.7	2,237.4	877.1
1990	247.9	1,058.4	.3	2,151.9	1,092.4
1991	140.8	591.4	3,284.8	1,814.2	1,012.9
1992	111.7	394.2	.2	605.9	1,363.7
1993	81.1	184.5	2,090.0	2,690.2	1,114.4
1994	84.6	452.5	.2	1,837.7	1,350.8
1995	78.4	296.4	2,701.9	406.1	740.2
1996	76.5	161.7	.1	317.9	779.6
1997	77.4	145.0	1,876.5	1,362.7	416.6
1998	54.0	155.1	.9	537.1	816.9
1999	92.6	108.0	51.8	20.5	248.9
2000	80.2	404.5	.4	547.9	294.8
2001	132.2	392.1	780.8	255.4	1,572.9
2002	113.9	298.3	.3	476.0	1,951.5
2003	92.1	252.2	1,234.7	273.4	1,542.1
2004	101.2	572.1	.7	218.7	1,919.1

Table 3.24 Total Salmon Catch by Year and Species in Puget Sound and the Strait of Juan de Fuca (Treaty and Non-treaty commercial, take-home, C & S; freshwater and marine areas 4B-13) Source: WDFW, 2005 fish ticket data.

incidental catch that is permissible in order to provide the fishers with the opportunity to fish for abundant runs from other species. Recent regulations designed to reduce the incidental catch and mortality of Puget Sound Chinook have reduced the incidental contribution to less than one percent of the total catch of all other species in Puget Sound fisheries (Figure 3.24) (CWDFW, 2005 fish ticket data).

Puget Sound Recreational Harvest

Within Puget Sound, recreational fisheries occur in both marine and freshwater areas. "Since the mid-1980's, the total annual marine harvest of Chinook salmon has steadily declined to levels of less than 50,000 Chinook salmon in recent years." (NMFS, 2004) (See figure 3.25.) These fisheries occur during the summer months

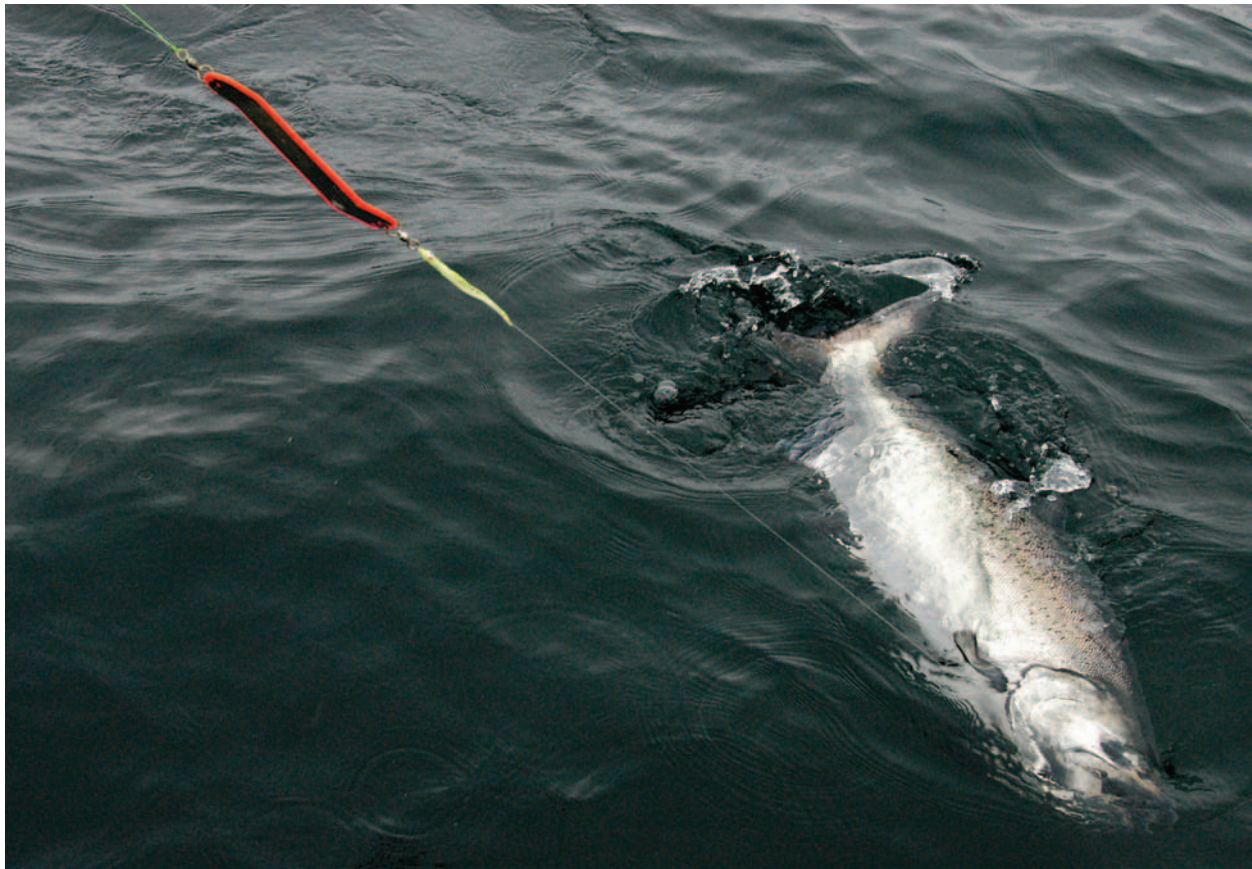


Photo by Dan Kowalski.

Chinook salmon caught by recreational angler.

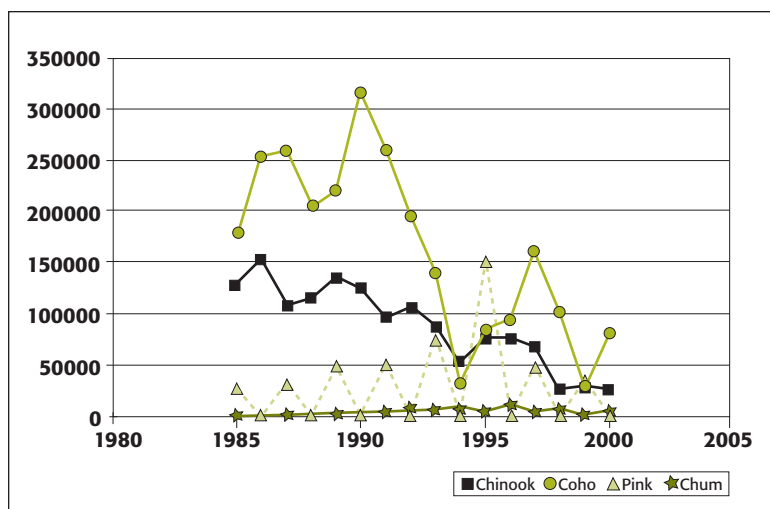


Figure 3.25 Number of Chinook salmon caught in Puget Sound marine recreational fisheries from 1985 to 2000 (NMFS, 2004).

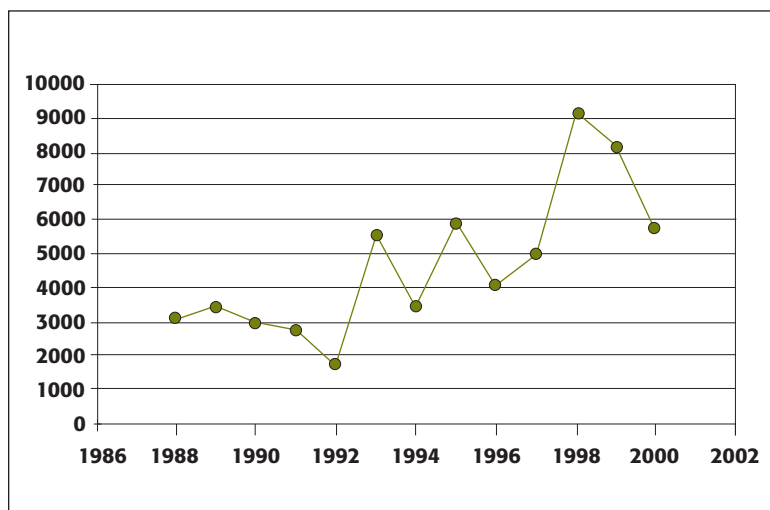


Figure 3.26 Number of Chinook salmon harvested in Puget Sound freshwater recreational fisheries from 1988 to 2000 (NMFS, 2004).

targeted primarily on coho and Chinook salmon, and continue during the fall and winter to target immature Chinook salmon called “Blackmouth.”

The recreational catches of Chinook in Puget Sound marine waters have been constrained in a similar manner to commercial fisheries in an effort to protect weak Chinook populations. As a response to increasingly restricted bag limits and shorter fishing seasons in open marine waters to preserve commingled weaker populations, the recreational harvest of Chinook in freshwater areas has shown an increase since the early 1990s (fig-

ure 3.26). Since these fisheries occur within the terminal areas of the various salmon runs, it is easier to target a directed harvest on stronger salmon populations than is possible in pre-terminal areas.

Ceremonial and Subsistence Fisheries

The treaty Indian tribes of western Washington also schedule “ceremonial and subsistence” fisheries for Chinook salmon and other species. Subsistence fishing provides tribal members with basic nutritional benefits from eating salmon, and the economic and personal reward derived from catching one’s own food. At many tribes, subsistence fishing is regulated on a structure parallel to the Washington State recreational fisheries, with punch cards or forms to report catches and similar seasonal and area openings. Some tribes utilize standard fish reporting tickets to report ceremonial and subsistence catch. Ceremonial fisheries occur in response to the cultural and traditional needs of the tribes, and are generally scheduled as needed for funerals, first salmon ceremonies, annual gatherings and other tribal ceremonies involving the full tribal community. Ceremonial

and subsistence harvests are small in proportion to commercial and recreational catches, with annual harvest of a few hundred Chinook or less. Such fisheries typically open for a few hours or days, with participation limited to one or few boats.



Traditional tribal method of cooking salmon on stakes, Lummi Tribe.

Photo by Dan Kowalski.

"When times were tough, I remember my dad bringing home salmon to feed us and he'd bring some for the neighbors too. It isn't just enough for us to protect the salmon; It is part of our culture to consume them as well."

Terry Williams, Tulalip Tribes

Harvest Effects on Hood Canal Summer Chum

Although fisheries are not directed on Hood Canal summer chum a sizeable number of Hood Canal summer chum have been harvested incidentally during fisheries directed at Chinook and coho, which have overlapping run timing. Substantial incidental catches in Strait of Juan de Fuca and Hood Canal fisheries in the 1980s prompted the NMFS Biological Review Team to consider past harvest levels to be a factor

of decline for the Hood Canal summer chum in its 1998 status review (NMFS/BRT, 1998). Prior to 1974, commercial salmon fishing was prohibited in Hood Canal, with the exception of the Skokomish Indian Reservation. Following the opening of commercial fishing in the Canal in 1974, incidental harvest rates of summer chum climbed rapidly, reaching 50-80 percent in most of the Canal, and exceeding 90 percent in some areas in the 1980s. During

the high harvest years, harvest rates on individual summer chum populations averaged 20 percent (NMFS/BRT, 2003).

Summer chum salmon are also harvested incidentally in British Columbia in pink and sockeye fisheries in the Strait of Juan de Fuca, Johnstone and Georgia Straits; and in troll fisheries off the west coast of Vancouver Island (63 FR, 11774-11795). Canadian harvest declined in the 1990s due to significant reductions in coho and sockeye fishing. Chum salmon are regulated in the same major harvest management forums as Chinook.

In 1991, coho salmon fishing in the main part of Hood Canal was closed by the co-managers to

Population	1974 – 1979 mean exploitation rate (%)	1980 – 1991 mean exploitation rate (%)	2000 – 2004 mean exploitation rate (%)
Combined Quilcene	29.6	90.4	14.1
Dosewallips	24.4	47.9	1.5
Duckabush	24.4	47.9	1.5
Hamma Hamma	24.4	47.9	1.5
Jimmycomelately	9.4	21.2	0.4
Lilliwaup	24.4	47.9	1.5
Salmon	11.9	21.2	0.5
Snow	11.9	21.2	0.5
Union	57.6	54.9	1.5

Figure 3.27 Estimated exploitation rates on populations of Hood Canal summer chum salmon from 1974 to 2004. (S. Bishop, pers. comm., NMFS)

protect natural coho runs, and modifications were made to the remaining coho and Chinook fisheries throughout Puget Sound to protect summer chum. As a result of these efforts, exploitation rates on summer chum in Hood Canal have declined greatly, and have dropped to a cumulative average (including Canadian fisheries) of five percent or less in recent years.

Additional information on the effects of harvest management on Hood Canal Summer Chum is contained in the Summer Chum Conservation Initiative (WDFW & PNPTT, 2000) and the Hood Canal/ Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan (in progress) by the Hood Canal Coordinating Council.

Harvest Effects on Coastal/Puget Sound Bull Trout

Core bull trout areas in the Olympic Peninsula and Puget Sound Management Units have experienced current and historical impacts to bull trout from fisheries management. Incidental mortality to bull trout during recreational fisheries and the commercial harvest of other salmonid species is considered to be a major factor leading to the decline in bull trout abundance. As a predatory species, bull trout have also suffered from the decline of local populations of salmon.

Although char have not historically been the target of recreational anglers in the Coastal/Puget Sound region, it is believed that the incidental catches of bull trout during fisheries for steelhead, trout and salmon exceeded the population's productivity. As bull trout mature slowly, harvest that occurs prior to full maturity and reproduction has a significant impact on their viability. The migratory nature of bull trout between freshwater and saltwater causes them to pass through various harvest locations repeatedly during their life cycle. Bull trout are also highly susceptible to hooking mortality during other targeted recreational fisheries.

Unlike some Chinook salmon populations, bull trout in some core areas appear to have

responded to restrictions on harvest. For example, prior to 1994, bull trout/Dolly Varden were allowed to be kept as part of the general trout bag limit in the North Fork of the Skykomish River. In 1994, WDFW enacted a conservation measure that disallowed retention of bull trout in key bull trout areas. A three-fold increase in bull trout redds in the North Fork Skykomish followed (figure 3.28; WDFW, 2005).

In addition to recreational fisheries, the illegal harvest of bull trout persists in some core areas within Puget Sound and may have significant localized impacts. These activities are difficult to enforce due to the remote nature of bull trout spawning areas. The tendency of bull trout to aggregate prior to spawning also makes them vulnerable to illegal harvest. The USFWS identified a number of illegal harvest hot spots in the Puget Sound region, which are primarily located adjacent to upper river campgrounds.

Commercial gill net fisheries that target steelhead and salmon near the mouths of Olympic Peninsula rivers are also associated with bull trout mortalities. Additional information on the relationship between fisheries management and bull trout related to seasons, bag limits, and fishing locations is contained in the Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (USFWS, 2004).

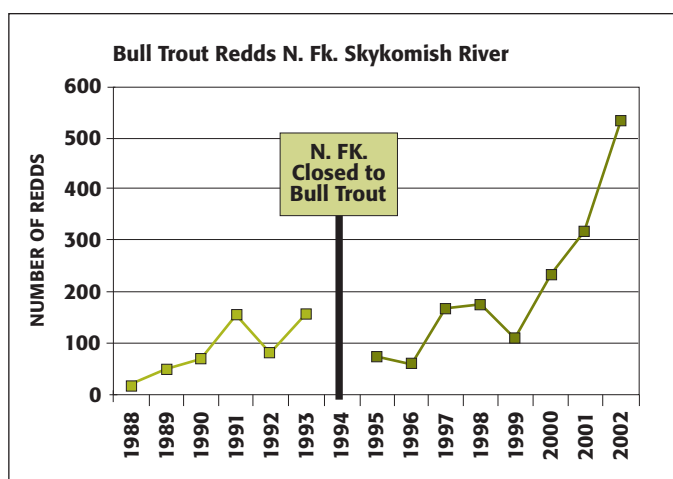


Figure 3.28 Number of Bull Trout Redds in the North Fork Skykomish River (WDFW, 2005)